CHILDREN AND FIRE

The Experiences of Children and Fire in the United States

Federal Emergency Management Agency
United States Fire Administration
National Fire Data Center

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CHILDREN AND FIRE IN THE U.S.

Each year in the U.S. hundreds of children are injured or killed in fires. This report presents a detailed look at fires involving children and answers questions including:

- the number of children killed in fires in 1991,
- the U.S. counties with the highest rates of child fire deaths,
- death rates among different ethnicity groups,
- characteristics of fires that kill and injure children,
- the importance of smoke detectors in preventing child deaths and injuries, and
- characteristics of children playing fires.

This report is based on an analysis of two data sources: 1983-1991 data on child mortality from the National Center on Health Statistics (NCHS) and 1993 data from the National Fire Incident Reporting System (NFIRS).[1] These two data sets answer different questions about the relationship of children to fire in the U.S. The NCHS data set includes all fire-related deaths for the 1983 through 1991 period. Using this data we can isolate infants and children through nine years of age to determine 1) the total number of child fire deaths that occurred in 1991, 2) the counties in which fatalities occurred, and 3) the ethnicities of victims.

The NFIRS data is a large yearly sample of all fires, deaths, and injuries that occur in the United States, and 1993 data is used for this analysis. Proportions drawn from the NFIRS data set are used in this report to describe fires associated with child deaths and injuries. Absolute numbers, while available in NFIRS, are not cited because the data set is a sample rather than a complete record of all fires and related deaths and injuries. NFIRS data provide information on fires of all types including residential fires, which are responsible for the majority of fire-related deaths and injuries among children. NFIRS also contains a classification for children playing fires, and the final section of this report deals with the characteristics of how most children playing fires are set. This is an important topic because children playing fires account for a disproportionate share of all fire-related deaths and injuries among children.

[1] The NCHS data set includes all years from 1983-1991 except 1985.

A DEMOGRAPHIC PROFILE OF CHILD FIRE VICTIMS

Child Fire Death Rates

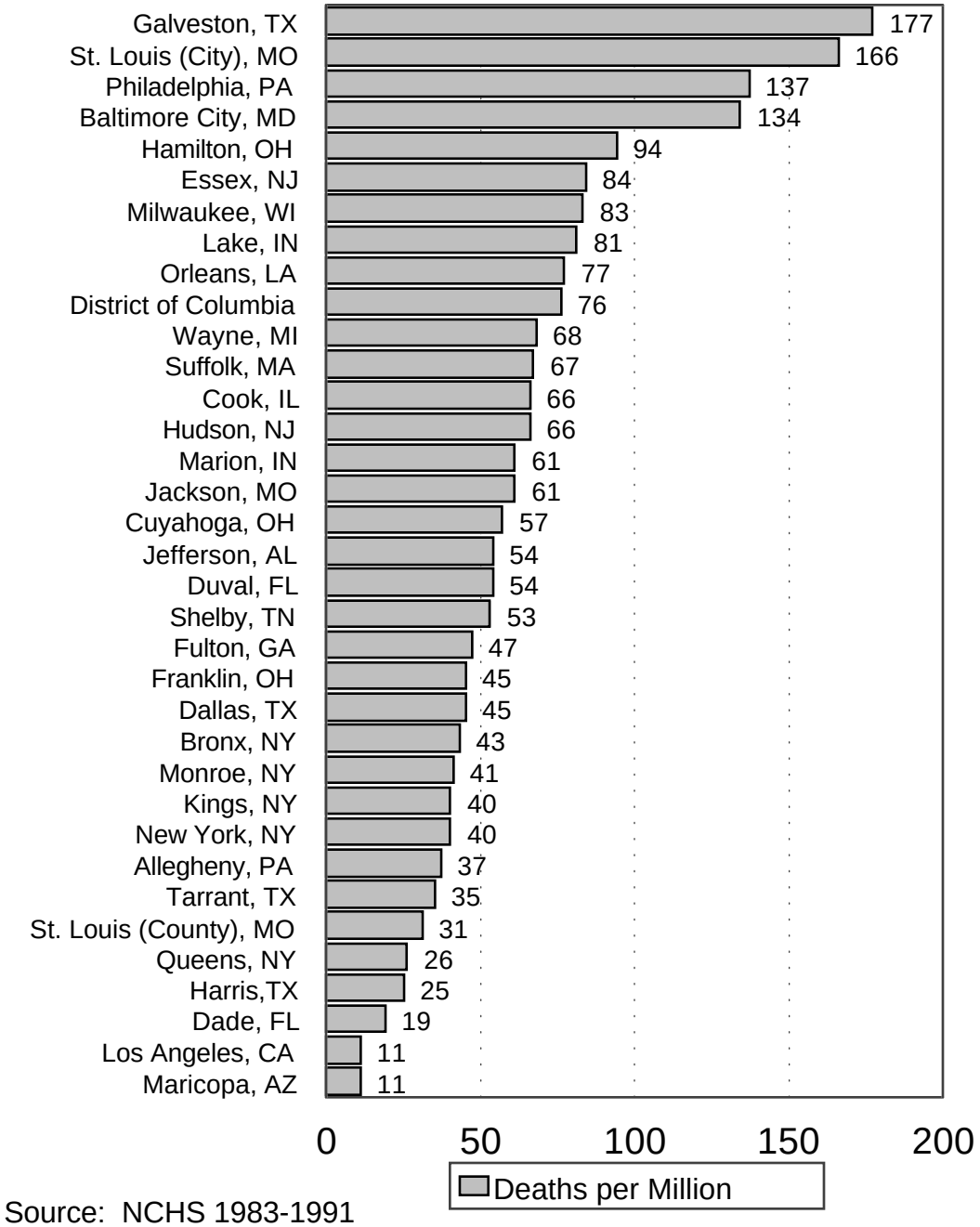
Figure 1 presents a list of U.S. 35 counties with the highest rates of child fire deaths per million population for the 1983-1991 period. Galveston, TX tops the list with 177 deaths per million population. The other four counties with the highest rates of child deaths were St. Louis (City), MO, Philadelphia, PA, Baltimore, MD, and Hamilton, OH. In terms of absolute numbers of deaths (Figure 2), the five counties with the most child fire deaths were Cook County, IL, Philadelphia, PA, Wayne County, MI, Los Angeles County, CA, and Baltimore City, MD.

Variations in Risk

While the overall risk of dying in a fire is higher for children than it is for the general population, this risk varies significantly depending on age, sex, and race. Table 1 displays the number of 1991 fire deaths relative to population size for children under nine years old and for various subgroups of this population. The last column of the table, relative risk, calculates the risk of each category of children relative to the general population, whose relative risk is set at 1.0. Younger children, those under four years old, are two times more likely than the general population of dying in a fire (relative risk = 2.17). Older children aged five through nine, on the other hand, have a lower risk of dying in a fire than the general population (relative risk = 0.81).

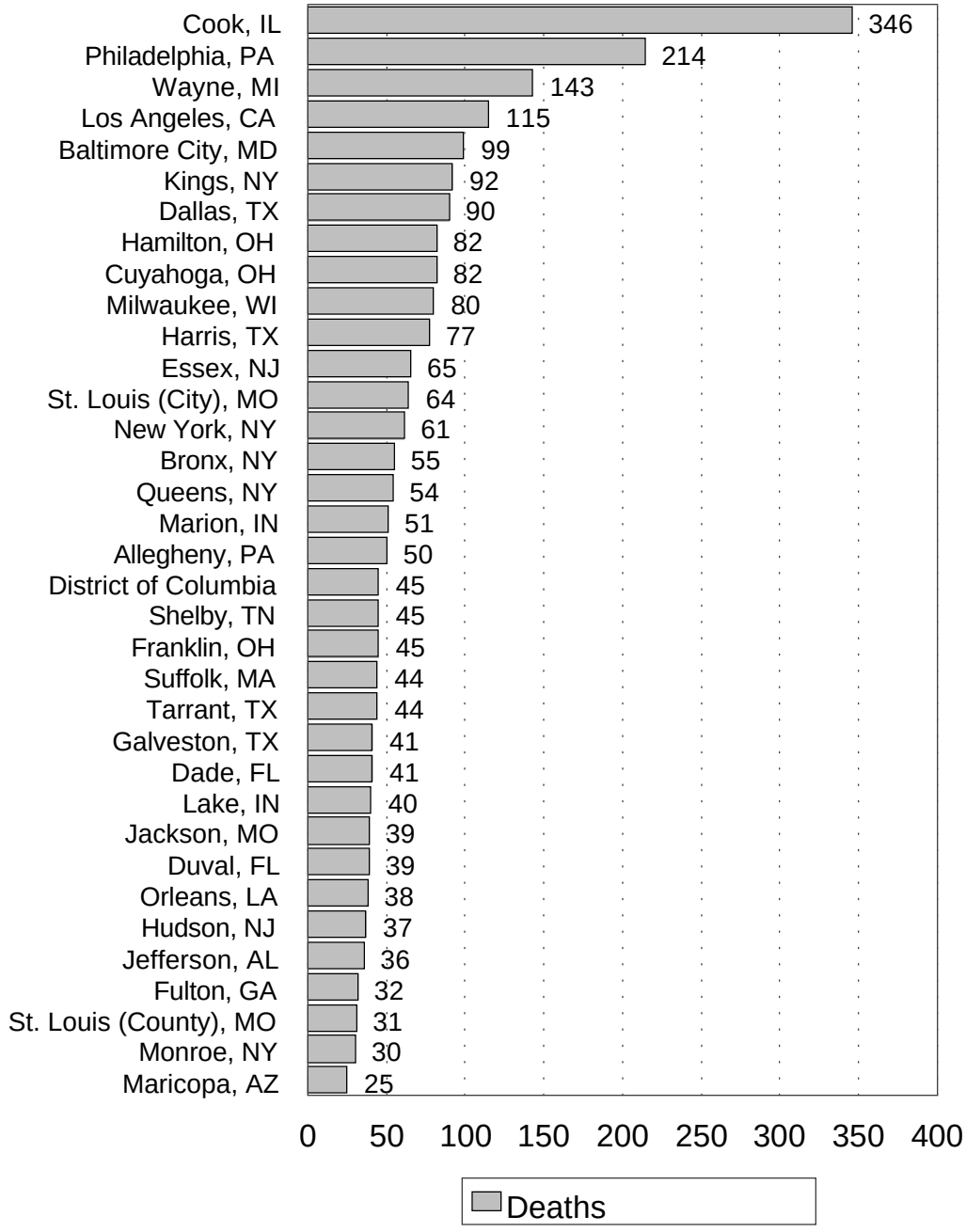
For both age categories of children, boys have a higher risk of fire death than girls. This is evident in both per capita death rates for boys and girls and in terms of their standardized, or relative, risk.

Figure 1. Counties with the Highest Per Capita Fire Deaths Among Children Ages 0-9



Source: NCHS 1983-1991
(excluding 1985)

Figure 2. Counties with the Highest Number of Fire Deaths Among Children Ages 0-9



Source: NCHS 1983-1991
(excluding 1985)

Table 1. Fire Deaths by Age, Sex, and Ethnicity

Age	Sex and/or Ethnicity	Overall Population	1991 Fire Deaths	Deaths Per Million	Relative Risk*
0-9	**Total**	**36,390,997**	**1,051.00**	**28.88**	**1.49**
0-4	**Total**	**18,264,096**	**767.00**	**41.99**	**2.17**
	Males	9,350,461	434.00	46.41	2.40
	Females	8,913,635	333.00	37.36	1.93
	Whites	13,645,942	461.00	33.78	1.75
	African Americans	2,754,917	289.00	104.90	5.42
	Native Americans	197,796	13.00	65.72	3.40
	Asians	574,433	4.00	6.96	0.36
	White Males	7,007,803	261.00	37.24	1.93
	White Females	6,638,139	200.00	30.13	1.56
	African American Males	1,391,992	160.00	114.94	5.95
	African American Females	1,362,925	129.00	64.65	4.90
	Native American Males	100,857	11.00	109.07	5.64
	Native American Females	96,939	2.00	20.63	1.07
	Asian Males	294,068	2.00	6.80	0.35
	Asian Females	280,365	2.00	7.13	0.37
5-9	**Total**	**18,126,901**	**284.00**	**15.67**	**0.81**
	Males	9,290,556	161.00	17.33	0.90
	Females	8,836,345	123.00	13.92	0.72
	Whites	13,669,939	180.00	13.17	0.68
	African Americans	2,670,822	96.00	35.94	1.86
	Native Americans	197,456	5.00	25.32	1.31
	Asians	587,783	3.00	5.10	0.26
	White Males	7,024,997	104.00	14.80	0.77
	White Females	6,644,942	76.00	11.44	0.59
	African American Males	1,353,071	55.00	40.65	2.10
	African American Females	1,317,751	41.00	31.11	1.61
	Native American Males	101,840	0.00	0.00	0.00
	Native American Female	96,616	5.00	52.29	2.71
	Asian Males	299,954	2.00	6.67	0.35
	Asian Females	287,829	1.00	3.47	0.18

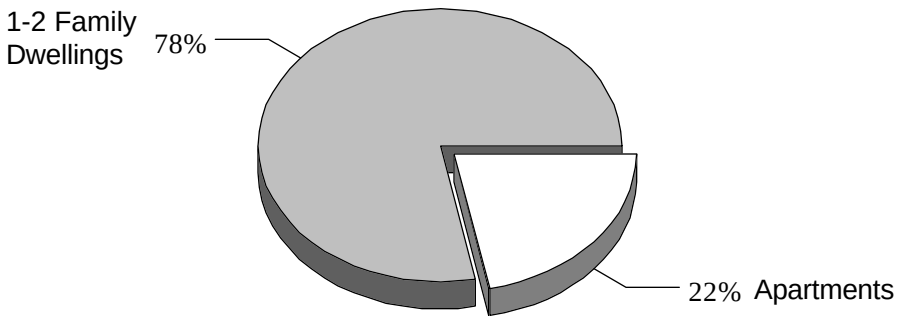
*Where the relative risk of the general population is 1.00, based on a fire death rate of 19.35 per million population for the U.S. as awhole.

Of particular concern is the variation in fire death risk based on ethnicity. African American children are at significantly higher risk of fire death, particularly relative to their white counterparts. Overall, African American children are over three times more likely to die in a fire than white children. Within these categories, Table 1 shows that the group at highest relative risk is African American males under age four (relative risk = 5.95). Deaths in this group totaled 461 in 1991, or over 40 percent of all children who died as a result of fires that year. The relative risk for African American males is thus six times that of the general population. Native American males under age four are close behind, with a relative risk of 5.64, but their absolute number of deaths in 1991 was low at 11. The next group most at risk is African American females under age four. Deaths for this group totaled 129 in 1991, and the relative risk for this group is 4.90.

RESIDENTIAL FIRES

Where Fires Occur

Eighty-five percent of all fires that injure or kill children are residential fires. Figure 3 presents a breakdown on dwelling type for fires that killed children in 1993. The majority (78 percent) of these fires occurred in one- and two-family dwellings, and almost all the rest occurred in apartments (22 percent).



Source: NFIRS 1993

Area of Fire Origin

Table 2 compares the top-ranking "areas of fire origin" for three categories of residential fires: 1) residential fires that resulted in deaths to either adults or children, 2) residential fires that resulted in at least one child death, and 3) children playing fires that resulted in at least one child death. The first row of the table shows that fires that killed children were most likely to originate in a lounge area or sleeping area. Sixty-two percent of all residential fires that killed children started in one of these two areas. The third most common area of fire origin was the kitchen, though this area accounted for only nine percent of fires that resulted in a child fire death.

Table 2. Fatal Fires and Top-Ranking Areas of Fire Origin, 1993

Area of Origin	Lounge Area	Sleeping Area	Kitchen Cooking Area
Residential Fires, All Fatalities	29%	26%	14%
Residential Fires, with Child Fatalities	31%	31%	9%
Residential Children Playing Fires, with Child Fatalities	28%	54%	3%

Source: NFIRS, 1993

Table 2 reveals that, relative to all fatal residential fires (row 1), a slightly higher proportion of fires with child fatalities originate in sleeping rooms (row 2). This is likely attributable to the fact that children playing fires kill a high proportion of all children who die in fires, and the bedroom is often the room of choice for a children playing with matches or a lighter. The last row of Table 2 supports this statement. Of those children playing fires that resulted in a child fatality in 1993, over half (54 percent) originated in a sleeping area. This compares to 31 percent of all fires that resulted in a child fatality and 26 percent of fatal fires generally.

The relationship between children playing fires and fires that originate in bedrooms is even more dramatic when both deaths and injuries are considered. Table 3 is similar to Table 2 except that fires causing both deaths and injuries are considered, rather than fires causing deaths only.

Table 3. Fires Causing Casualties and Top-Ranking Areas of Fire Origin, 1993

Area of Origin	Lounge Area	Sleeping Area	Kitchen, Cooking Area
Residential Fires, All Fatalities	32%	24%	15%
Residential Fires, with Child Fatalities	20%	33%	19%
Residential Children Playing Fires, with Child Fatalities	4%	62%	18%

Source: NFIRS, 1993

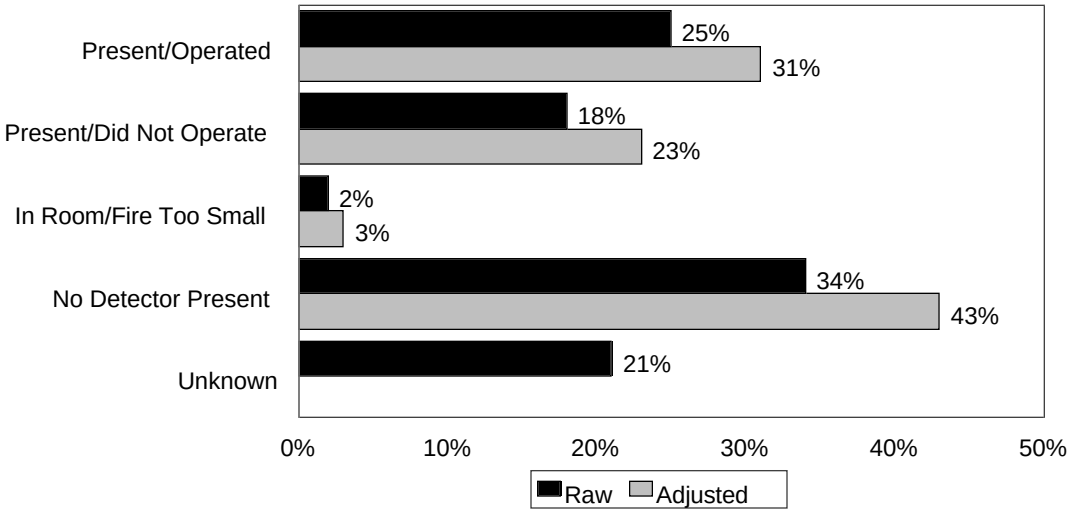
For all residential fires with casualties (row 1), the top-ranking category of area of fire origin is the kitchen. This is not unexpected, since a high proportion of all fire-related injuries result from cooking fires. But Table 3 shows that among residential fires with at least one child casualty in 1993 (row 2), more fires originated in sleeping areas than in any other area of the home. Considering just children playing fires with child casualties (row 3) reveals that over 60 percent of these fires originated in a sleeping area.

The Importance of Smoke Detectors in Saving Lives and Avoiding Fire Injury

Figure 4 provides dramatic testimony to the importance of smoke detectors in preventing fire injuries and deaths among children. In over one-third of the residential fires in which a child was injured or killed in 1993, there was no smoke detector present in the home. Considering only those cases in which the presence and operability of smoke detectors was known, this percentage rises to 43 percent. In another 23 percent of cases, a smoke detector was present in the room where the fire started or elsewhere in the home but did not operate. Thus in approximately 66 percent of the fires in which a child was injured or killed there was no operable smoke detector in the home. These facts highlight the importance of both installing and maintaining smoke detectors.

As noted above, the predisposition of children to start fires in bedrooms makes it particularly important to have smoke detectors placed in such a way that they will quickly alert parents to fires that children may set in sleeping areas.

Figure 4. Smoke Detector Performance in Residential Fires Resulting in Child Casualties



Source: NFIRS 1993

Figures may not add to 100% due to rounding.

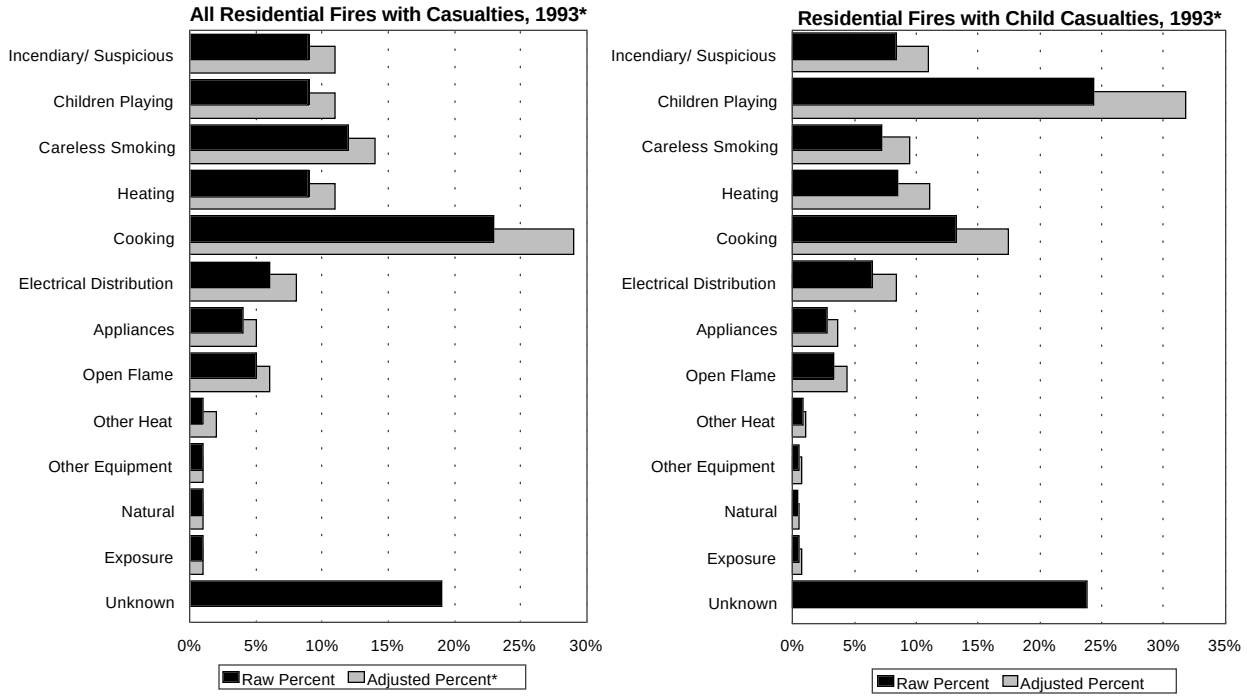
Causes of Residential Fires that Kill or Injure Children

The same "causes of fire" responsible for the greatest number of overall residential fire casualties also account for a majority of those fires that injure or kill children. These causes include cooking, careless smoking, incendiary/suspicious, children playing, heating, and electrical distribution. The difference is in the relative ranking of these fire causes. Figure 5 presents the distribution of fire causes for 1) all residential fires with deaths or injuries, and 2) residential fires in which at least one child under the age of nine was injured or killed.

Relative to all fires that result in casualties, either deaths or injuries, a disproportionate number of fires involving child casualties are started by children playing. While children playing fires accounted for only 11 percent of all residential fires with casualties in 1993, they accounted for 32 percent of fires that resulted in child casualties.

Figure 5 also shows that, relative to all residential fires with casualties, a lower proportion of fires with child casualties result from cooking or careless smoking fires. This is not surprising given that these activities more often associated with adults, and thus adults are likely to be closer to the area of fire origin and more likely to sustain injury.

Figure 5. Causes of Fires Resulting in Deaths or Injuries



Source: 1993 NFIRS * Adjusted percents figures spread unknown cases among known causes

The increased risk of child fire deaths or injuries associated with children playing fires is attributable to the proximity of the child to the area where the fire originates and the inability of children, especially very young children, to effectively escape from a fire because of limited physical capabilities and limited life experiences. As seen in the preceding section, many children start fires in bedrooms. This fact should serve as a reminder to parents to pay careful attention to their children's activities, no matter where in the house they are located. Some children may be attempting to conceal their activities by playing with matches or lighters in a bedroom. A special concern is children who wake up earlier than their parents and, perhaps knowing that they are not supposed to play with matches or lighters, use the opportunity to experiment.

Timing of Child Fire Deaths and Fire Injuries

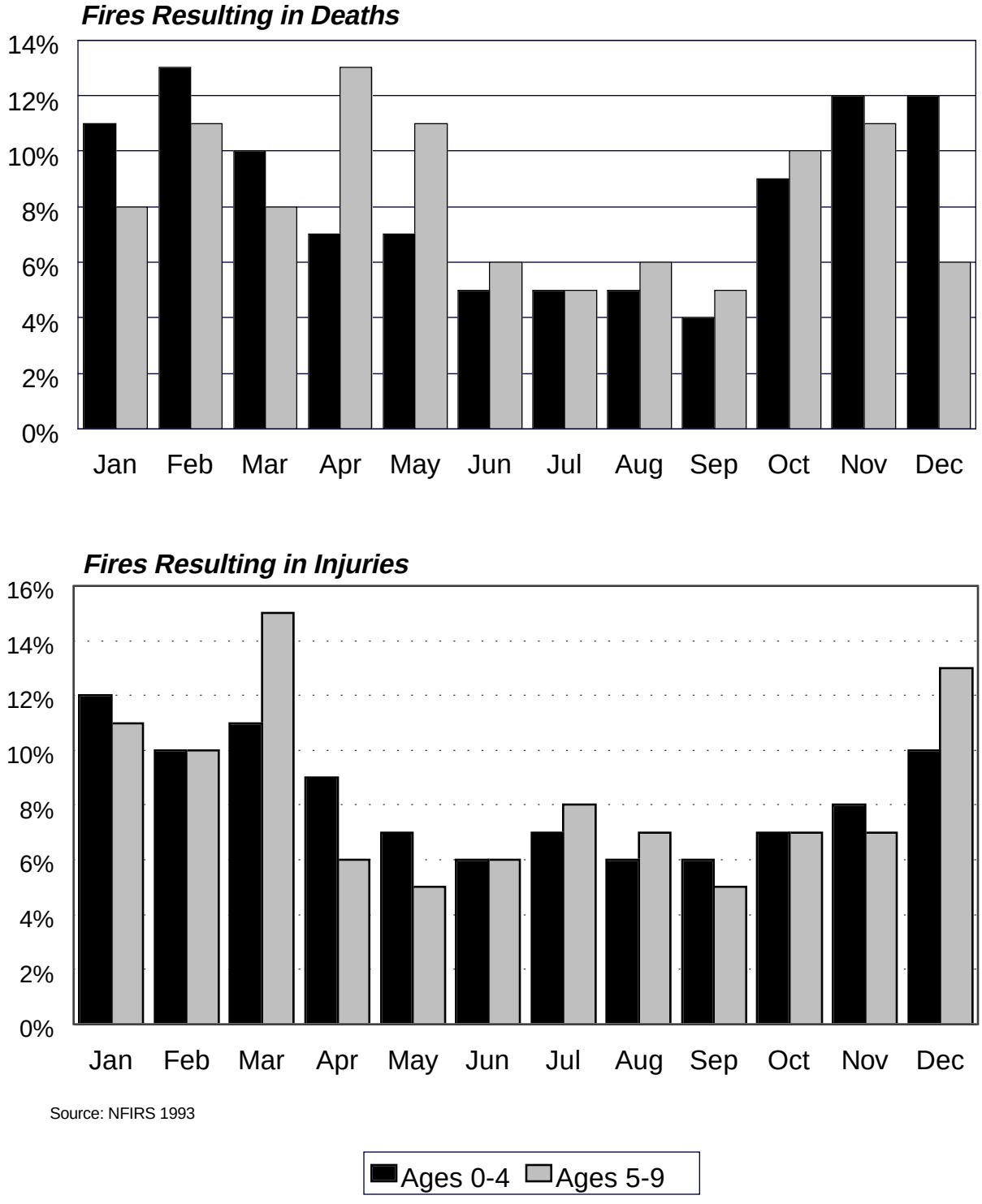
Seasonal Patterns

Trends in fires that result in child deaths and injuries mirror residential fire trends generally. Considering the 1993 distribution of fatal and injurious fires by month reveals an increase in the number of these fires in the winter months (Figure 6). This is attributable to the fact that people generally spend more time indoors during the colder, winter months and more fires occur, especially heating fires. An exception to this pattern is the high percentage of deaths among children ages five through nine that occurred in April and May.

Figures 7 and 8 show that these patterns generally pertained to 1993 children playing fires as well. Children playing fires that resulted in child deaths and injuries occurred more often in the winter months. Deaths and injuries from children playing fires are likely to be more frequent in the winter months because children spend more time playing indoors, increasing the likelihood of a child playing with fire and setting a fire in a residential structure.

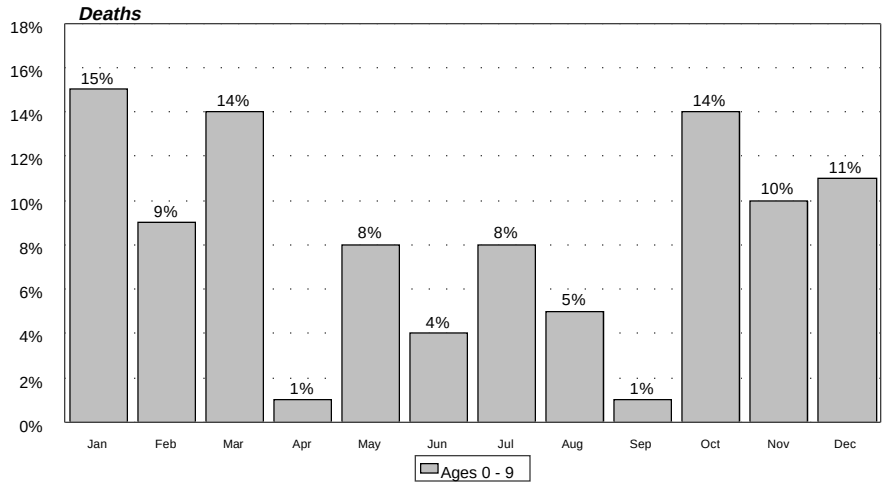
In Figure 7 and other charts referring to deaths associated with children playing fires, children of all ages are grouped together. This is necessary because the 1993 NFIRS contains only eight cases of children aged five through nine who died in children playing fires, compared to 71 children aged four and under. Put another way, almost 90 percent of all child deaths associated with children playing fires in the 1993 NFIRS were aged four and under. Beyond this, it is not possible to identify unique patterns between the two groups of children because of the small number of cases of children aged five through nine.

Figure 6. Residential Fires Resulting in Child Deaths or Injuries by Month



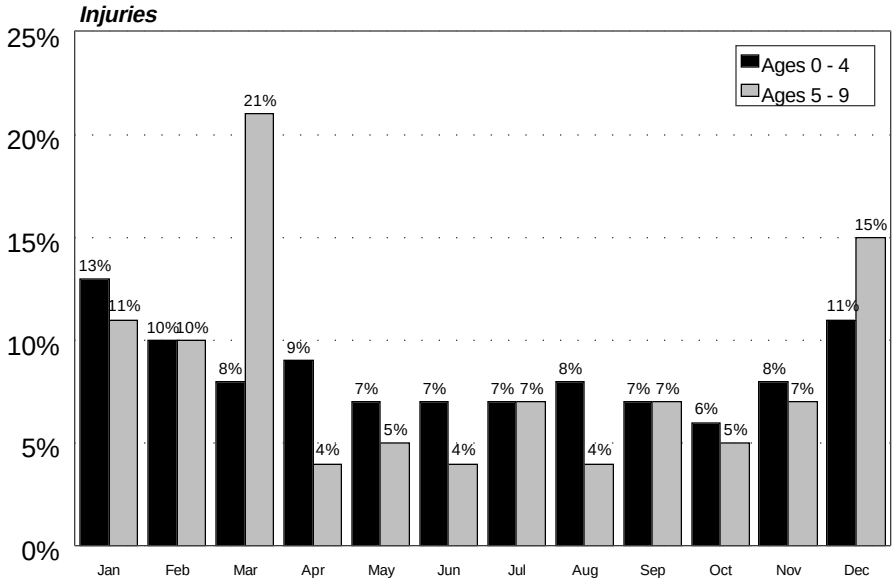
Source: NFIRS 1993

Figure 7. Residential Child Playing Fires Resulting in Child Deaths, 1993



Source: NFIRS, 1993

Figure 8. Residential Child Playing Fires Resulting in Child Injuries, 1993

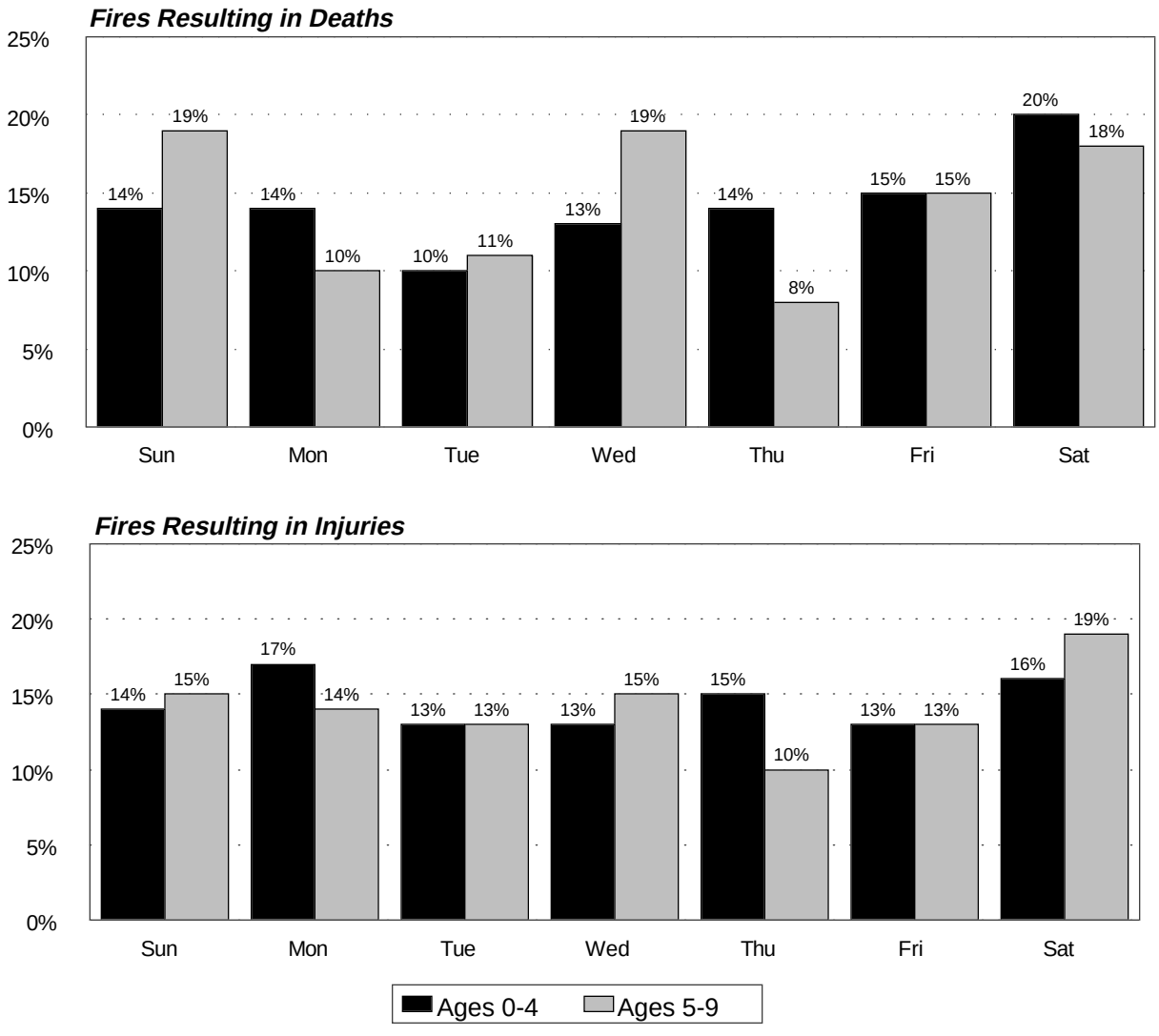


Source: NFIRS, 1993

Day of the Week

Considering the days of the week, there is a slight increase in the frequency of fatal and injurious fires on the weekends (Figure 9). This corresponds to the slight increase in the frequency of residential fires generally on these days. The increased risk to children on these days is at least in part due to the fact that many children are home from school on the weekends. Comparing the top and bottom charts in Figure 9 reveals that the trend toward an increase in fatal or injurious fires on the weekends is stronger for fires that cause deaths than for fires that cause injuries.

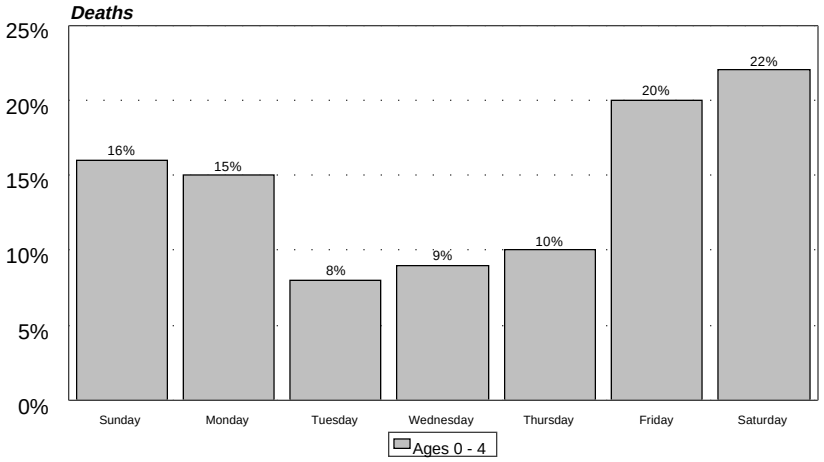
Figure 9. Residential Fires Resulting in Child Deaths and injuries



Source: 1993 NFIRS

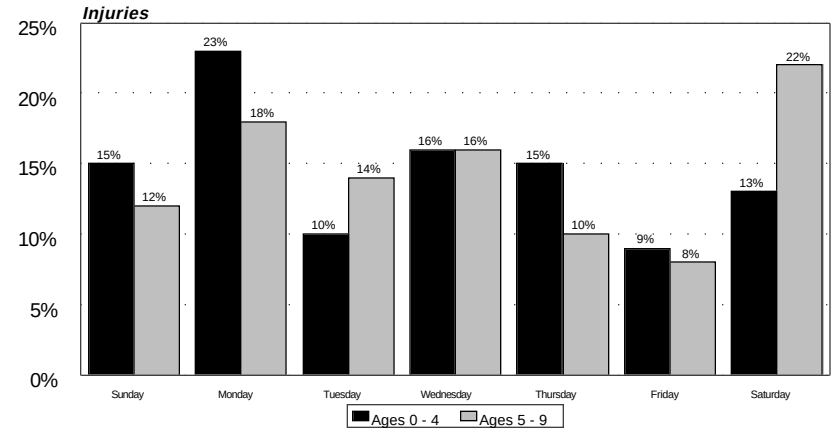
For children playing fires, there is a much clearer increase on the weekends in fires that result in child fatalities than was evident for fires of all causes (Figure 10). On the other hand, the distribution of children playing fires that result in child injuries does not reveal a pattern over the days of the week (Figure 11).

Figure 10. Residential Child Playing Fires Resulting in Child Deaths, 1993



Source: NFIRS, 1993

Figure 11. Residential Child Playing Fires Resulting in Child Injuries, 1993



Source: NFIRS, 1993

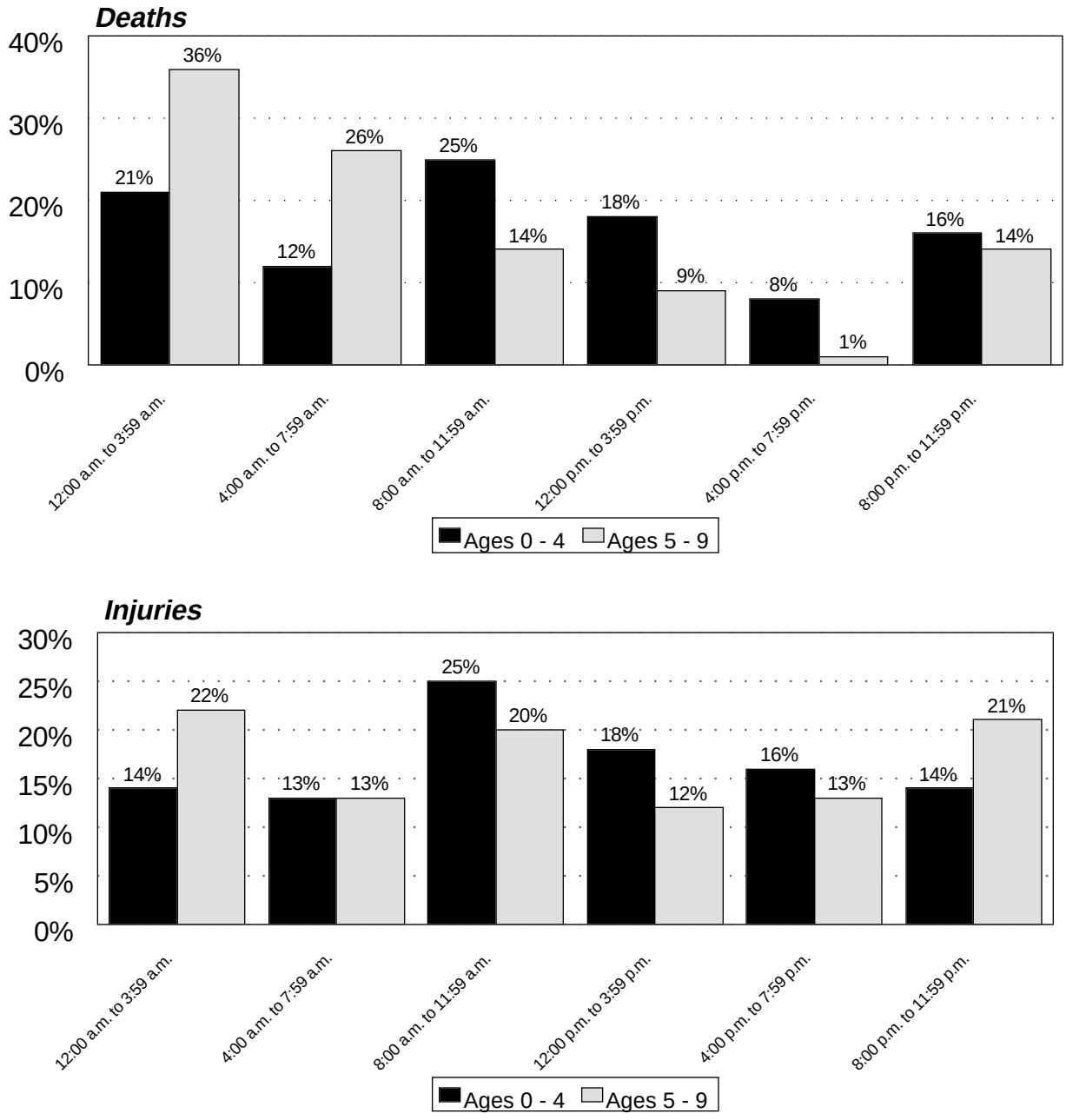
Time of Day

Figure 12 shows the distribution of 1993 residential fires that resulted in the death of at least one child by time of day. In contrast to most of the charts above, where the patterns were generally similar for both deaths and injuries, there are important differences between fires that tend to kill children versus fires that tend to injure them when they are broken down by time of day.

In 1993, for all children ages nine and under, fatal fires peaked in the early morning hours, when household members were likely to be asleep. Over half of all fires resulting in deaths (55 percent) occurred during nighttime hours, or between 8 o'clock in the evening and 8 o'clock the next morning. This trend is consistent with national trends for all fire deaths, two-thirds of which occur between 8 p.m. and 8 a.m. the following morning.

But this pattern does not pertain to both groups of children studied here. The time of day of fires had little effect on deaths among very young children, those ages four and under. About half of the fires occurred in the evening hours, between 8 p.m. and 8 a.m., and the other half occurred during daytime hours, between 8 a.m. and 8 p.m. (Figure 13). In contrast, the majority of fires (76 percent) that killed children ages five through nine occurred at night, when the children were more likely to be sleeping.

Figure 12. Residential Fires Resulting in Child Deaths or Injuries by Time of Day



Source: NFIRS, 1993

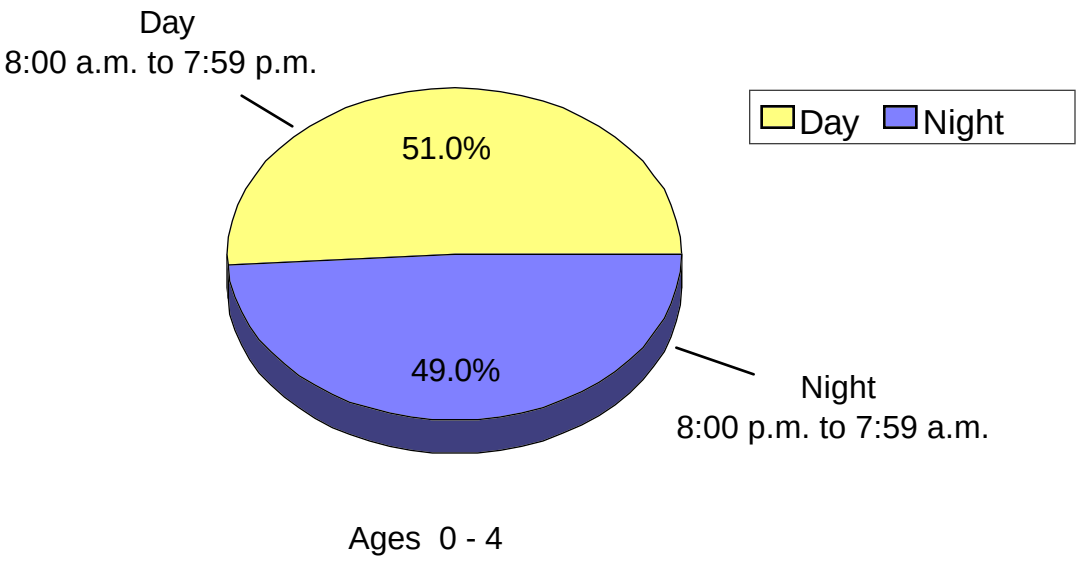
Considering fires that resulted in child injuries, 59 percent of fires that injured very young children occurred during the day, and 41 percent occurred at night (Figure 14). For the older group of children, the distribution of fires resulting in injuries was slightly more even, with 56 percent occurring at night and 44 percent occurring during the day.

As indicated above, one reason why nighttime fires are more dangerous than daytime fires for older children is because they are likely to be asleep. If a fire occurs during the day while they are awake, these children have a better chance of being alerted of the fire or noticing it themselves and escaping. Younger children have less understanding of fire and less mobility, especially infants and toddlers, making escape less likely than for older children regardless of the time of day unless an adult or older child assists them. Thus fires resulting in deaths and injuries among younger children are more evenly spread throughout the day than those for older children.

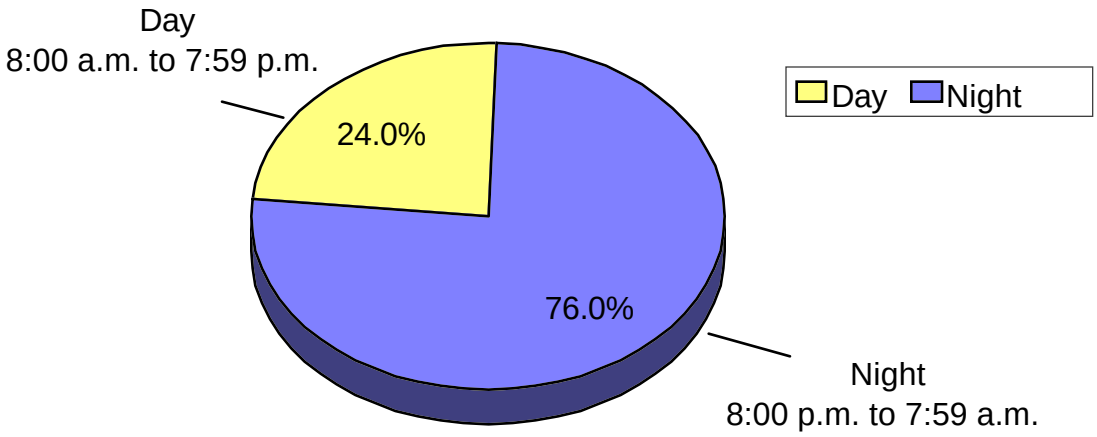
Another factor noted by Berl and Halpin is that tolerance to toxic combustion products is probably lowest at the bottom and at the top of the age distribution.[2] For this reason, younger children may be at greater risk of suffering injury or dying due to asphyxiation caused by fire. The NCHS data confirm the increased risk of fire death to younger children. In 1991, 767 children ages zero through four died, compared to 284 children ages five through nine. Using the relative risk rates cited earlier in this report, children in the younger age group are over two and one-half times more likely to be killed in a fire than children ages five through nine.

[2] Berl, Walter and Byron M. Halpin. Cited in Charles Jennings, "Urban Residential Fires: An Empirical Analysis of Building Stock and Socioeconomic Characteristics for Memphis, Tennessee." Doctoral dissertation, dated August, 1996, p. 65.

Figure 13. Residential Fires Resulting in Child Deaths by Time of Day



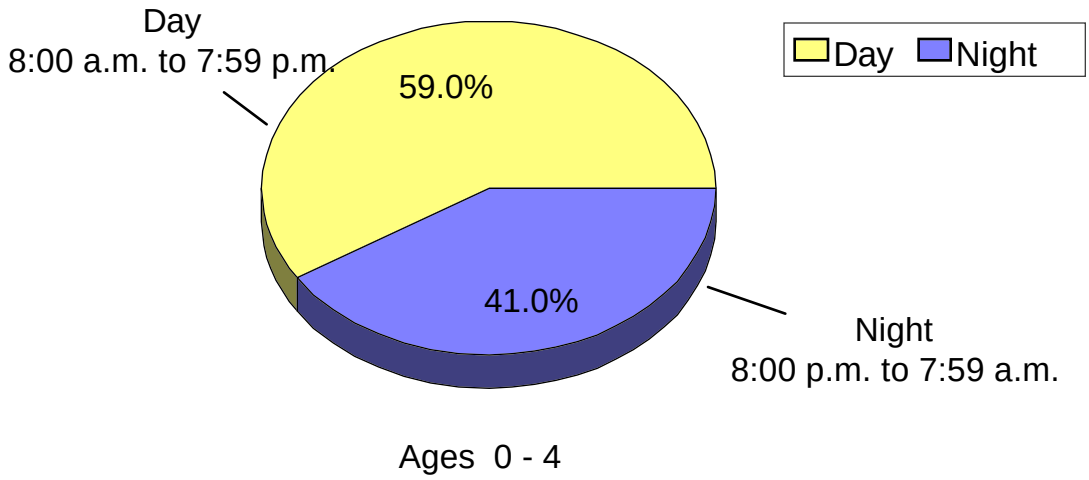
Ages 0 - 4



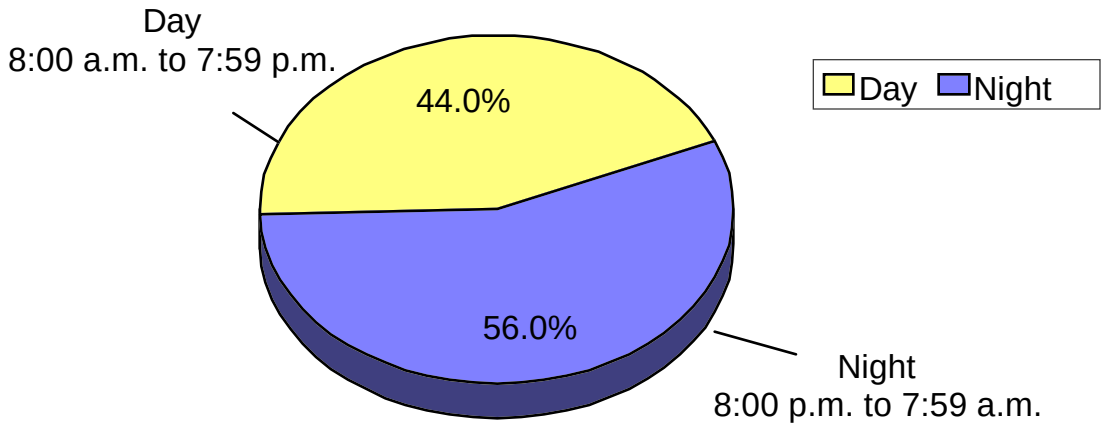
Ages 5 -9

Source: NFIRS, 1993

Figure 14. Residential Fires Resulting in Child Injuries by Time of Day



Ages 0 - 4

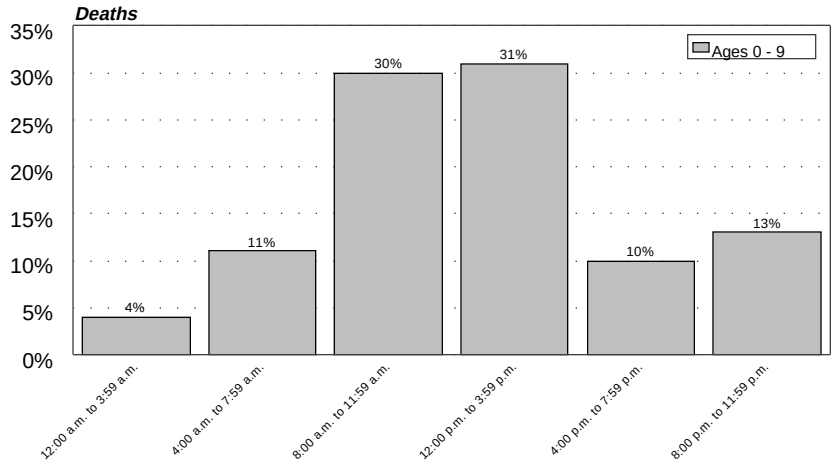


Ages 5 -9

Source: NFIRS, 1993

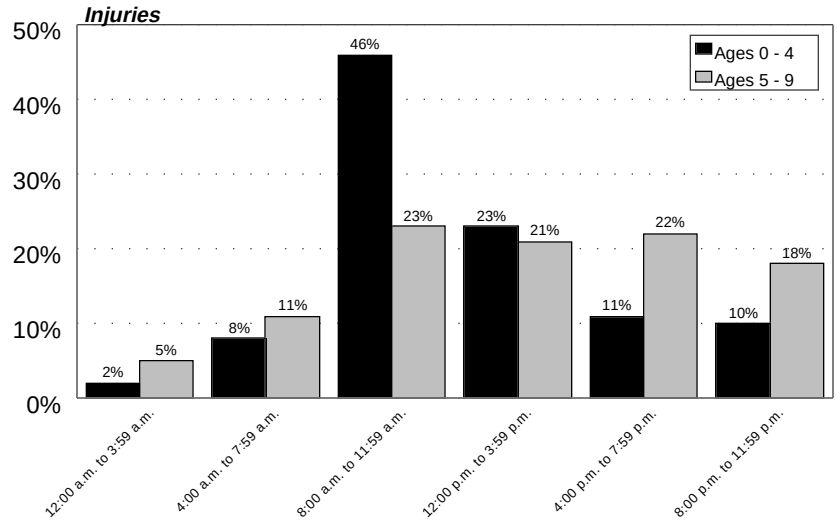
Turning our attention to children playing fires exclusively, it is not surprisingly to see that the majority of these fires with associated child deaths or injuries occurred during daytime hours when children were most likely to be awake (Figures 15 and 16).

Figure 15. Residential Child Playing Fires Resulting in Child Deaths, 1993



Source: NFIRS, 1993

Figure 16. Residential Child Playing Fires Resulting in Child Injuries, 1993



Source: NFIRS, 1993

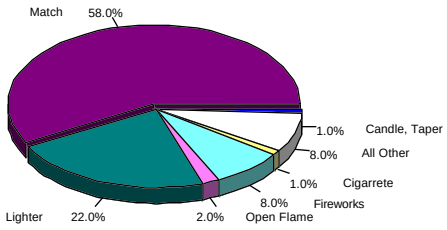
CHILDREN PLAYING FIRES

Form of Heat of Ignition

This section provides additional information on the nature of children playing fires because they account for a significant proportion of all child fire deaths and fire injuries. It is estimated that 25,400 children playing fires occurred in 1993. Using NFIRS data, Figure 17 displays the form of heat of ignition for children playing fires that occurred in 1993, regardless of where they were residential structure fires or other types of fires. Matches were by far the most common form of heat of ignition, accounting for 58 percent of cases. The easy availability of matches to children and their relative ease in use likely accounts for this high proportion of cases. Lighters were the second most common form of heat of ignition, accounting for 22 percent of children playing fires. These facts highlight the grave importance of keeping these materials out of the hands of children.

While matches account for a higher number of children playing fires that occur each year, fires started with lighters are more likely to injure children. In 1993, over half (52 percent) of all children playing fires that resulted in an injury to a child was started with a lighter. In comparison, fires started with a match accounted for 32 percent of all children playing fires with child injuries. Similarly, of all the children injured in children playing fires in 1993, 49 percent were injured in a fire started with a lighter, and 29 percent were injured in a fire started by a match.

Figure 17. Children Playing Fires by Form of Heat of Ignition



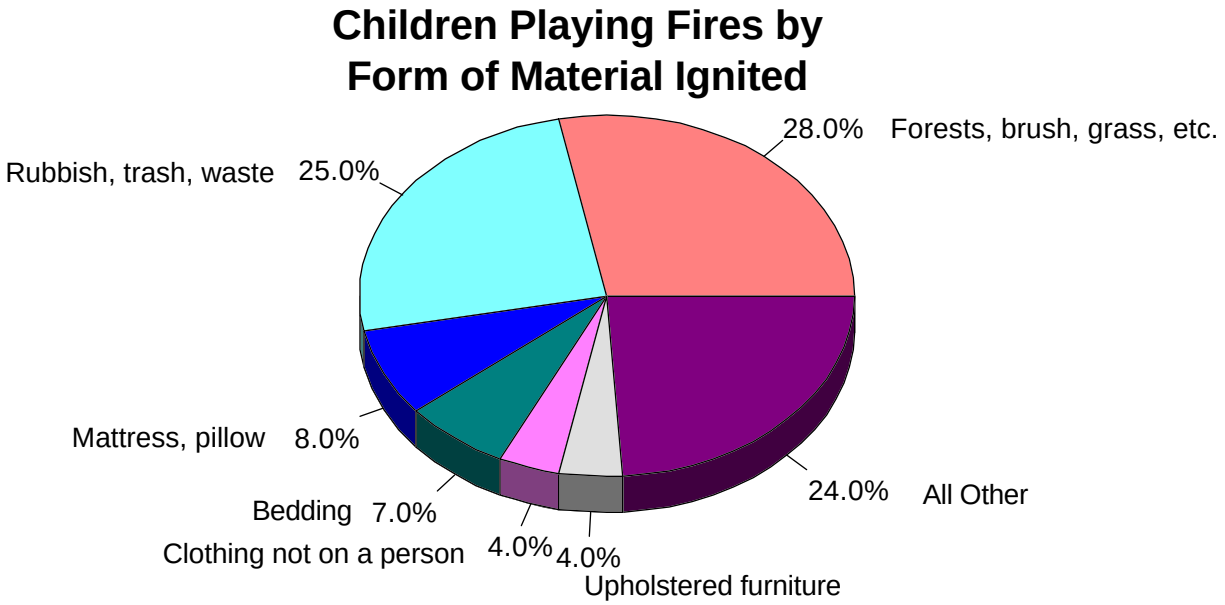
Source: NFIRS 1993

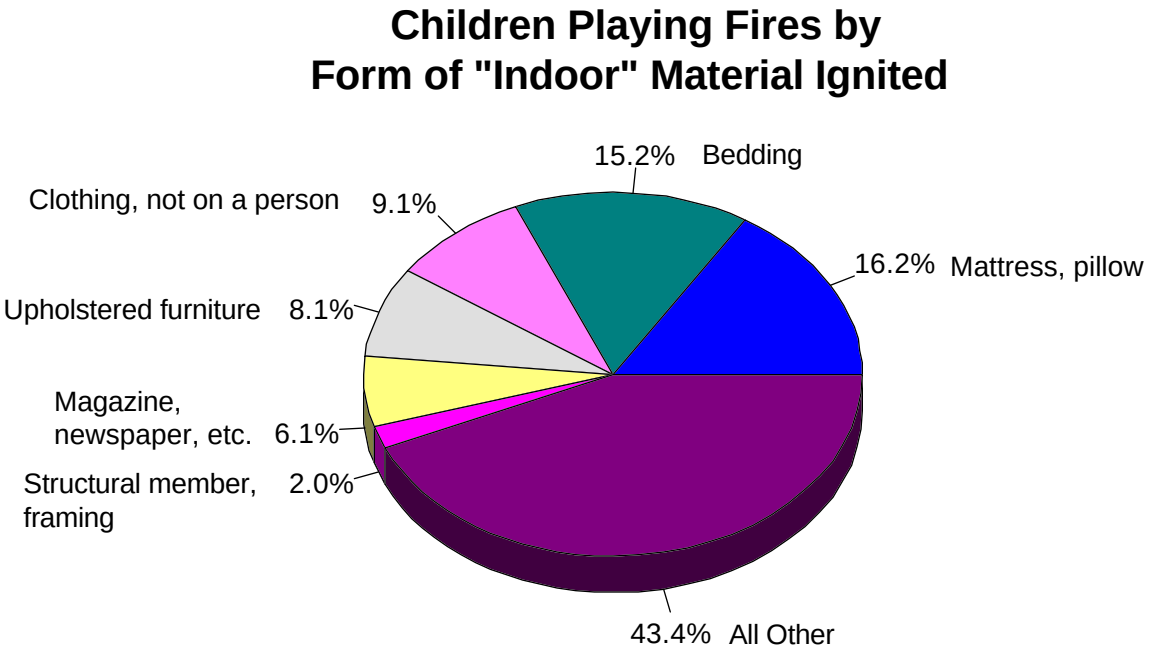
Material Ignited

The top chart in Figure 18 displays the form of material ignited for children playing fires in 1993. Interestingly, two categories most commonly associated with outdoor fires are implicated as the most common forms of material ignited. The first category is forests, brush, and grass, and the second category is rubbish, trash, and waste. The fact that so many fires are set by children outdoors raises an interesting methodological issue. "Children playing" fires include several categories of child fire setters. These are children too young to understand the dangerous implications of playing with fire (usually defined as age seven and younger), children above this artificial "age of reasoning" who are experimenting with fire, and children who set fires intentionally. This last category of children raises special concerns. Intervention may be needed to prevent these "children playing" firesetters from becoming juvenile firesetters and, perhaps, juvenile or adult arsonists.

The bottom chart in Figure 18 isolates forms of materials ignited that relate more closely to indoor locations. The materials most commonly associated with children playing fires in these cases are mattresses and pillows, with bedding ranking second. These materials are consistent with the room of origin of the majority of children playing fires set in residential structures: the bedroom. NFIRS data does not allow us to identify the age of a child who sets a fire, but one hypothesis is that younger children set more of the indoor children playing fires, especially those involving the ignition of mattresses, pillows, and bedding, and that older children are more involved with igniting materials found outdoors. This is consistent with the earlier finding that the majority of children killed in children playing fires are aged four and under.

Figure 18. Children Playing Fires by Form of Material Ignited



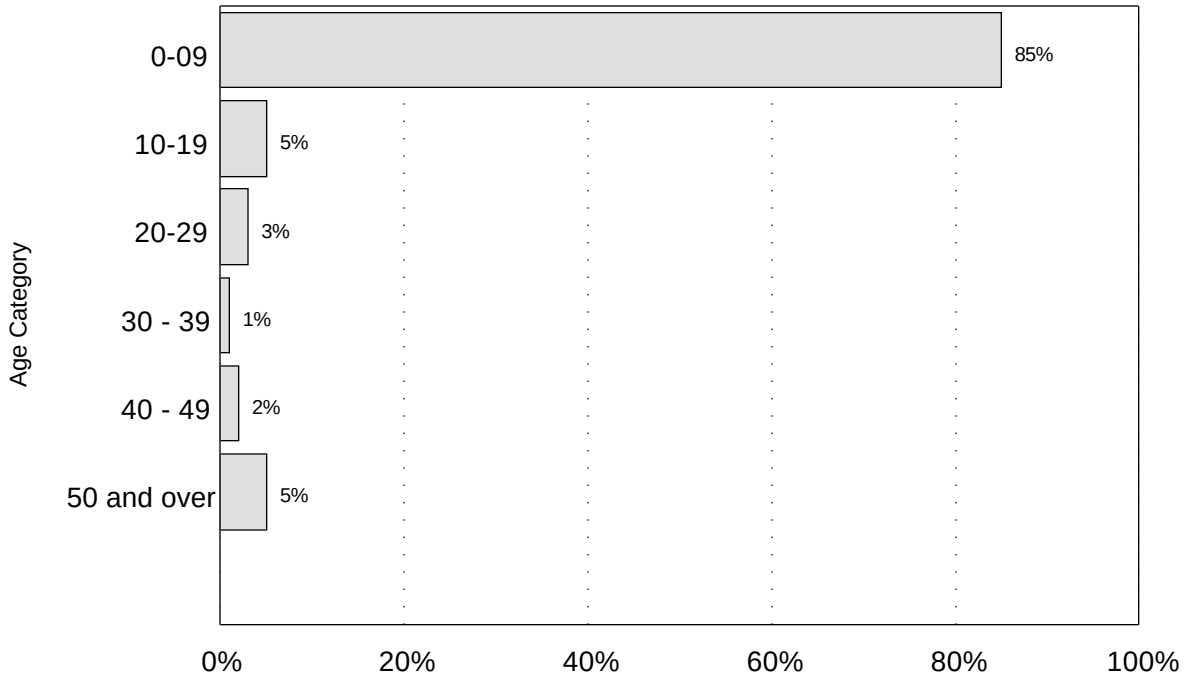


Source: NFIRS 1993

Victims of Children Playing Fires

NFIRS data does not allow identification of children who set fires versus children who are collateral victims of children playing fires. Thus Figures 19 and 20 below are based on all victims who were killed or injured in children playing fires in 1993. Figure 19 addresses deaths only. It reveals that 85 percent of the victims of children playing fires were themselves children. In many of these cases, the child who set the fire probably also died in it. Only 15 percent of fire deaths attributable to children playing fires were over the age of ten in 1993.

Figure 19. Residential Fire Deaths

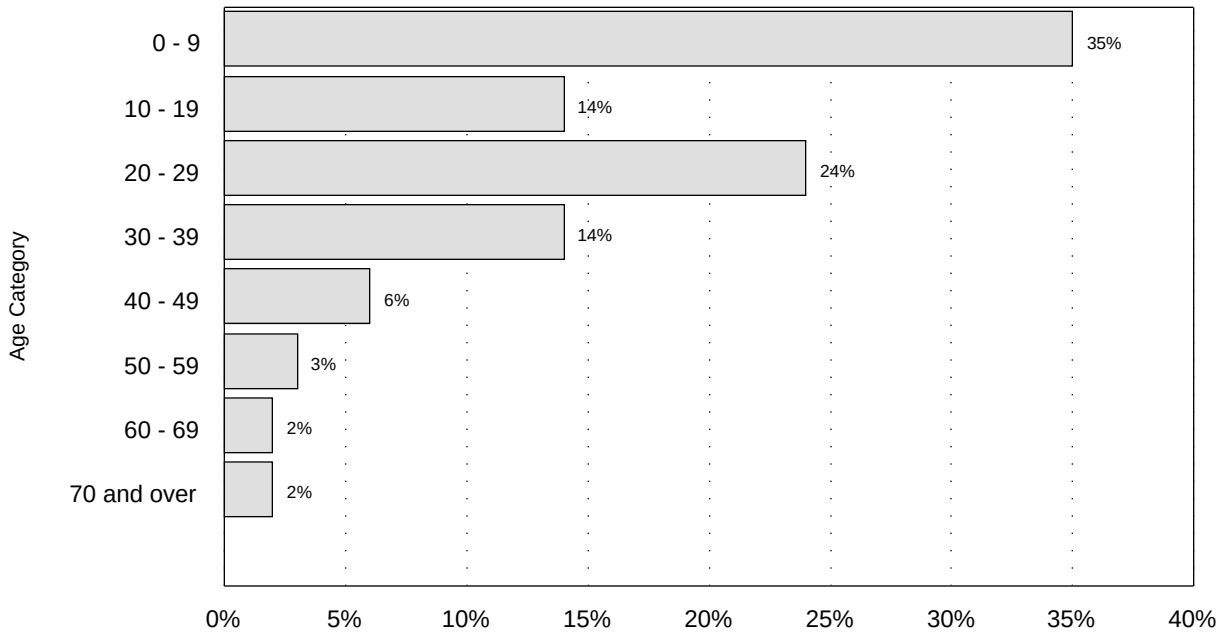


Source: NFIRS 1993

Figures may not add to 100% due to rounding.

Figure 20 shows that the picture is much different for injuries sustained in children playing fires than for deaths. Over one-third of persons injured in children playing fires were between the ages of 20 and 39. These victims were likely care givers who were at home with children who set fires by playing with matches or lighters. This is supported by the fact that only twelve percent of victims suffering injuries in children playing fires were age forty or older in 1993.

Figure 20. Residential Fire Injuries



Figures may not add to 100% due to rounding.

Source: NFIRS 1993

CONCLUSION

This report has highlighted a number of facts about the fire experiences of children in the U.S. that should help mold public education efforts aimed at this target group. Among the key findings are:

- All children do not experience the same risk. Younger children are at a significantly higher risk than older children, mostly because of their limited ability to escape from fires. Among all children under age nine, African American children face inordinate fire risks relative to children of other ethnicities. This report should 1) help public educators target their efforts and 2) provide vital statistics with which educators can reach out to affected groups to make them aware of the gravity of the situation.

- Deaths per capita vary significantly from place to place. Future analyses should undertake to determine whether high per capita county fire death rates among children are related to high rates of poverty.

- Trends in the time of year and day of week in which children are killed or injured in fires mirror national trends in the incidence of fires. The time of day analysis presented in this report, however, points out specific age-group patterns for fires that kill children. Whereas fires that kill children under four are fairly evenly spread throughout the day, fires that kill children between ages five and nine are more likely to occur at night, when they are home from school and asleep.

- A disproportionate number of child fire deaths occur in homes without operating smoke detectors. Universal installation and maintenance of smoke detectors is of the utmost significance for the prevention of future child fire deaths.

- Children playing fires are a significant part of the problem of child fire casualties generally. Almost one-third of all fires with child casualties are started by children playing. These fires tend to originate in sleeping areas and are usually started with matches or a lighter. The most common forms of material ignited indoors are mattresses, pillows, bedding, and clothing. These facts highlight the critical importance of adequate supervision of children. Children should never be left home alone. Even if they are not responsible for starting a fire, young children especially are at risk of being killed or injured if an adult is not home to help them escape should a fire break out.